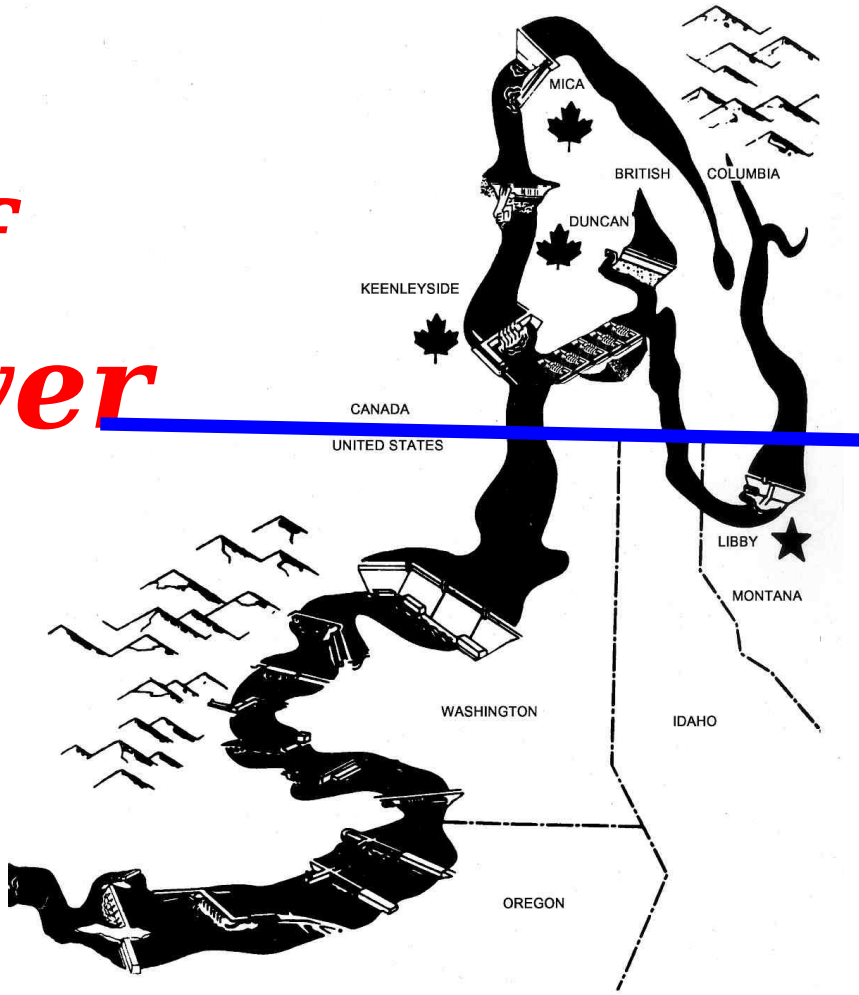
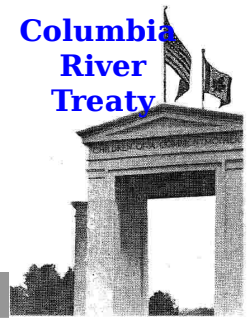
Columbia River Treaty

Overview of Columbia River Treaty



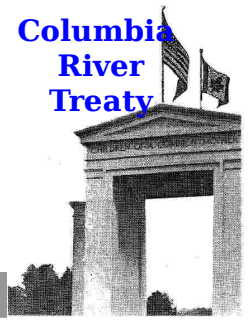
Columbia River Treaty



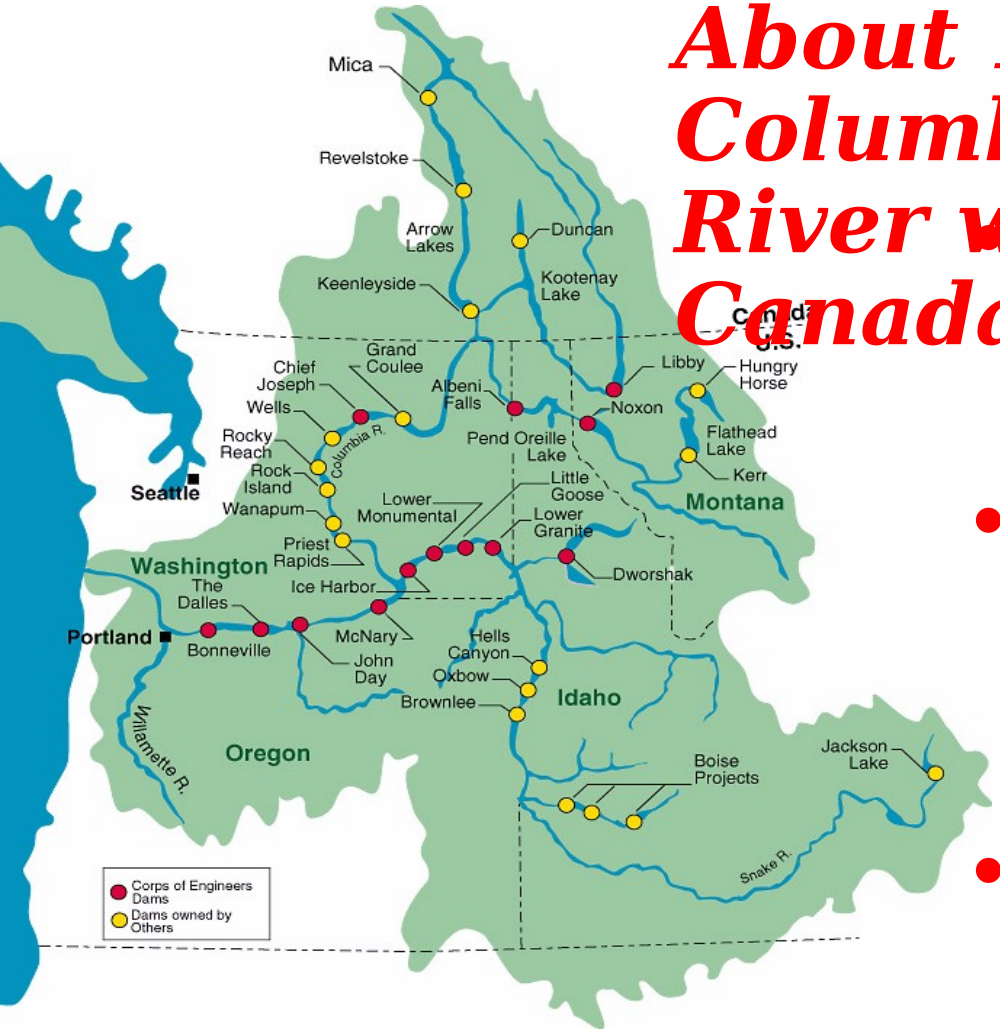
Topics

- Treaty Background and Projects
- Treaty Organization
- Treaty Provisions
- Treaty Studies and Operations
- Non-Treaty Storage

Why do we have a Treaty?

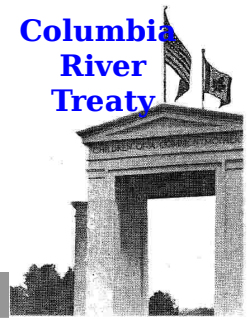


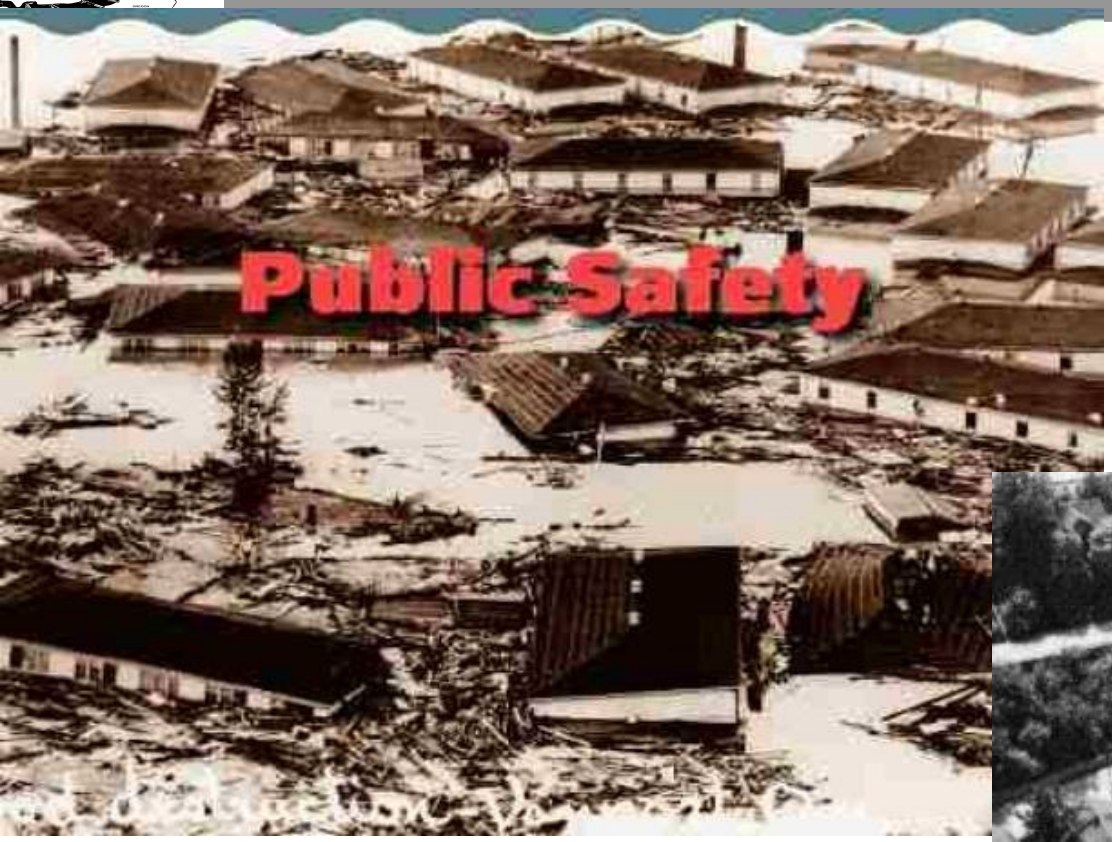
About 1/3 of the Columbia River water comes from Canada.



- Canada has 15% of the basin area, but produces, on average, 38% of the runoff for the total basin.
- 50% of the worst Columbia flood flows (1894) at Portland came from Canada.
- northern basins (Mica & Revelstoke) have highest and most consistent runoff
- runoff in southern basins is

1948 Columbia River Flood





- 1948 flood destroyed Vanport, Oregon, a city of ~ 35,000.

- Damaged homes, farms, and dykes from BC (e.g. Trail) all the way to Astoria, OR

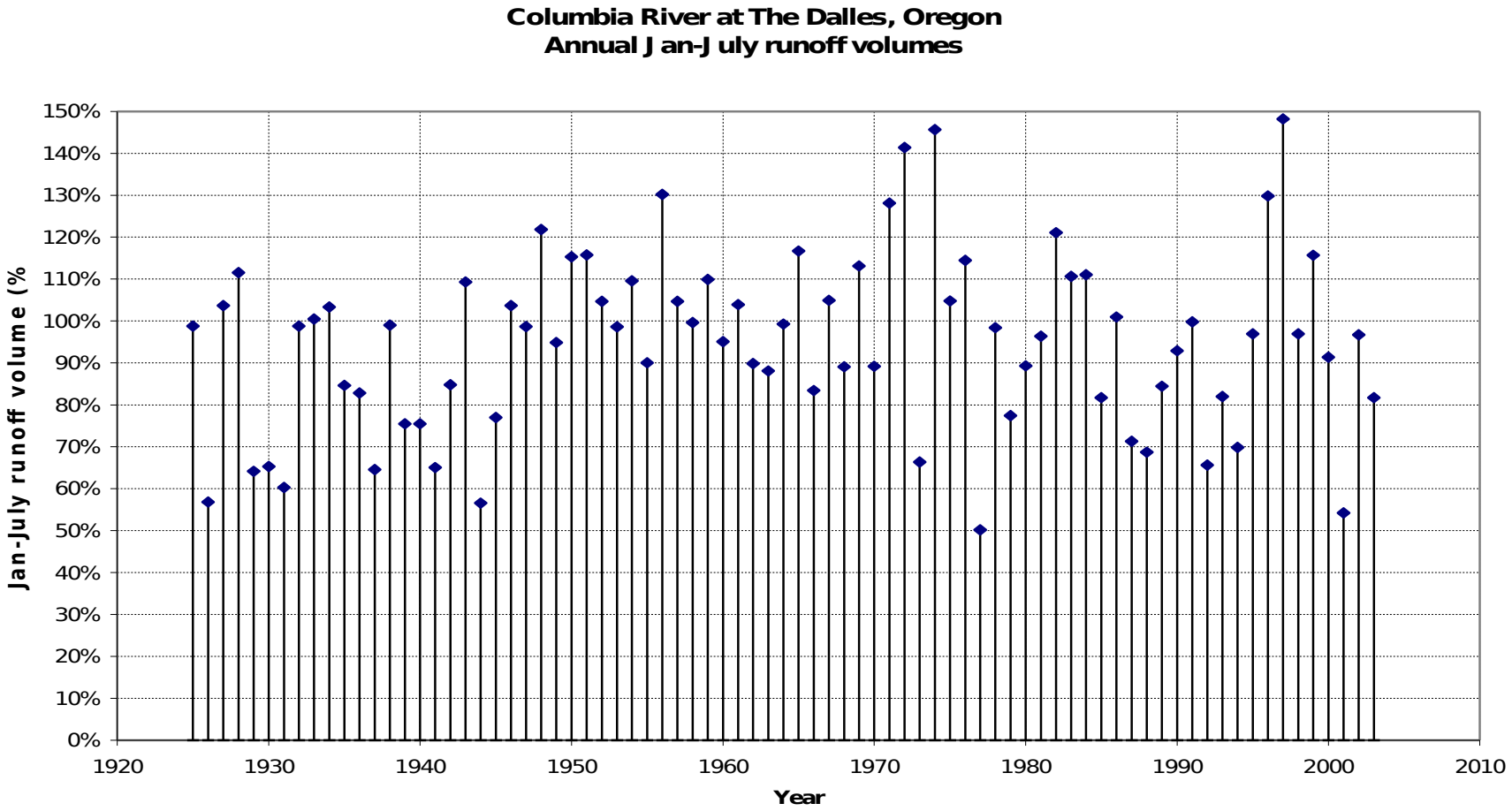
Columbia is the most powerful river in North America

- Hydropower capability is measured by river flow multiplied by the head (or, change in elevation).
- St. Lawrence, Mississippi, and Mackenzie rivers have more flow, but less head.
- Grand Coulee has about twice the head of Niagara Falls.

Grand Coulee Powerhouse & Spillway

Niagara Falls & Powerhouses

Year to Year Variation in Flow
About +/- 50% of Average

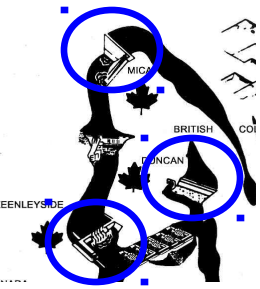


Year to year variations are almost random, and
95% confidence error for January forecast = +/- 25%

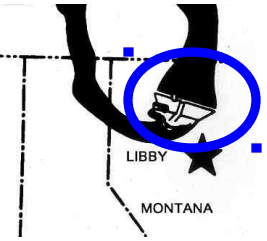
What does the Treaty Do?

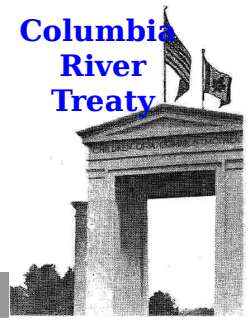
Columbia River Treaty

Jan.1961



- **The Treaty required Canada to:**
  - **construct the Mica, Arrow, and Duncan storage reservoirs on the Columbia River system,**
  - **operate these reservoirs for optimum power generation and flood control downstream in both countries**
- **The Treaty required the U.S. to:**
  - **pay Canada 50% of the estimated value of the future flood control benefits**
  - **deliver to Canada 50% of the increased power generated downstream at U.S. plants**
- **The Treaty allowed the U.S. to:**
  - **construct and operate the Libby project on the Kootenai River in Montana**





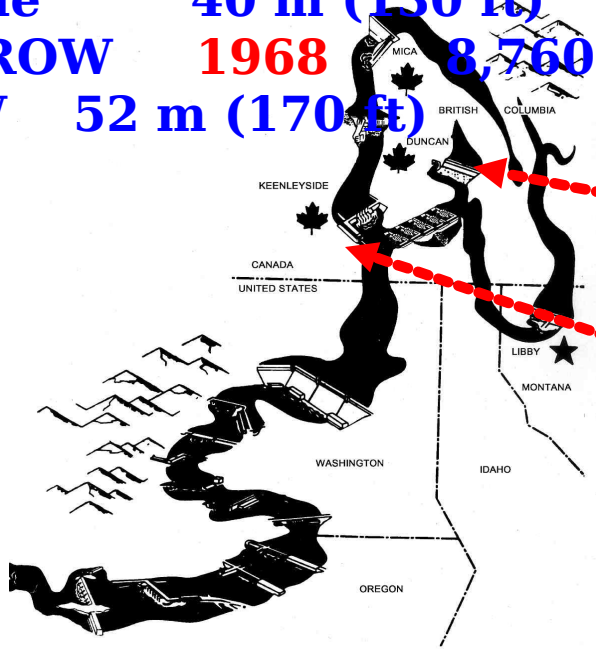
Treaty Term

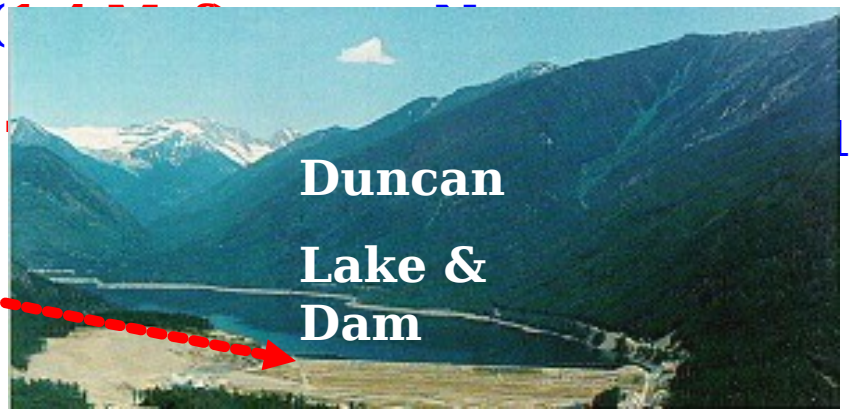
The Treaty has no specified end date. However, **either government has the option to terminate the Treaty after 60 years** (2024) with 10 years' advance notice. Upon termination:

- Mica, Arrow, Duncan, and Libby may continue to operate subject to the 1909 Boundary Waters Treaty
- Canada must provide "on-call" flood protection for the U.S. as long as the projects exist … but U.S. must pay Canada's operating costs and power losses
- Canada may continue any Kootenay River diversions (although no diversions have been undertaken so far)

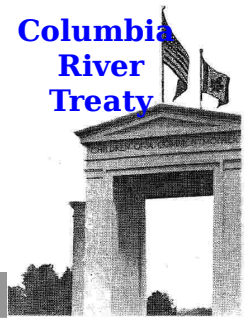
Duncan and Arrow

Generator	Dam Completed	Treaty Storage	Non-Treaty Storage	Capacity	Height
DUNCAN	1967	1,730 km³ (			
None				40 m (130 ft)	
ARROW	1968	8,760 km³ (			170
MW				52 m (170 ft)	





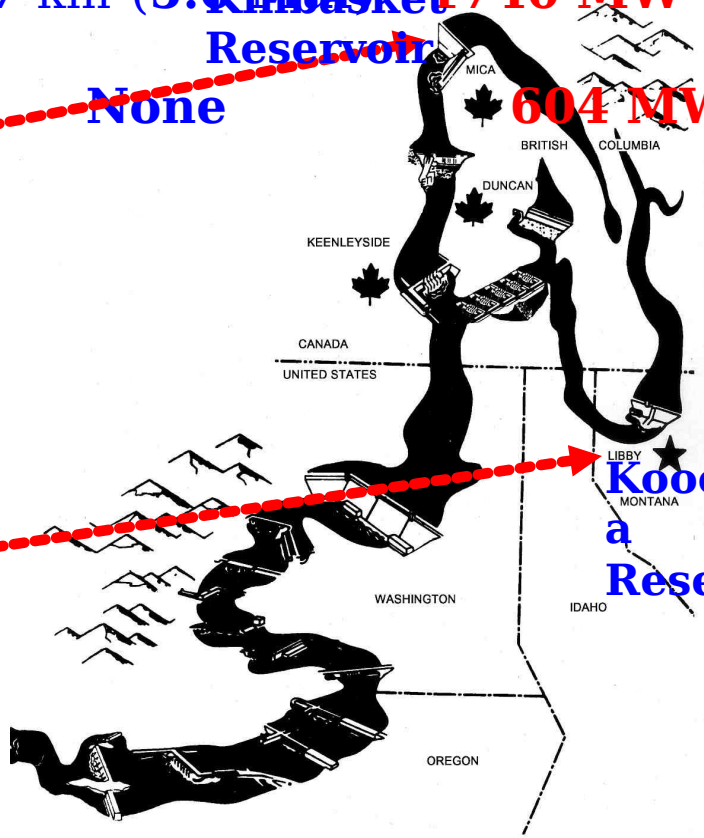
Mica and Libby



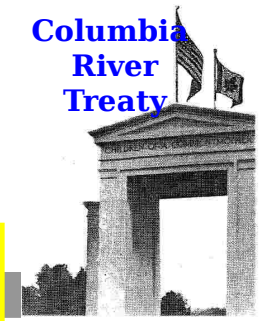
Dam	Completed	Height	Treaty Storage	Non-Treaty Storage	Generator Capacity
MICA	1973	198 m (650 ft)	14.8 km³ (12.0 Maf)	6.17 km³ (5.0 Maf)	1740 MW
LIBBY	1972	113 m (370 ft)	5.8 km³ (4.7 Maf)	None	604 MW

Kinbasket Reservoir

Koocanusa Reservoir



Columbia River Treaty Organization



CANADIAN GOVERNMENT
Ministry of Foreign Affairs & Trade
Ministry Natural Resources

BRITISH COLUMBIA GOVERNMENT

TREATY & Protocol

UNITED STATES GOVERNMENT
Department of State
Department of the Army
Department of Energy

CANADIAN ENTITY for Art.XIV2j*

CANADIAN ENTITY *

PERMANENT ENGINEERING BOARD *
CANADIAN UNITED STATES

United States ENTITY *

PEB ENGINEERING COMMITTEE ***
CANADIAN UNITED STATES

CANADIAN COORDINATOR & SECRETARY **

OPERATING COMMITTEE **
CANADIAN UNITED STATES

United States COORDINATOR & SECRETARY **

HYDROMETEOROLOGICAL COMMITTEE **
CANADIAN UNITED STATES

U.S. Entity

- Corps of Engineers
- BPA

Canadian Entities

- BC Hydro
- BC Provincial Government

* created by Treaty or governments, ** created by Entities, *** created by PEB

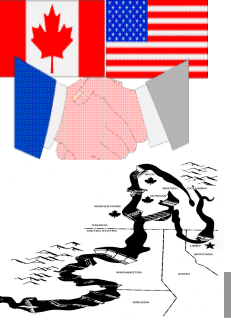
Treaty Provisions for Flood Control

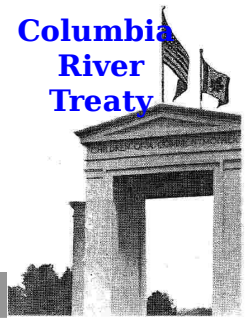
- 10.4 km³ (8.4 Maf) of storage at Arrow, Duncan, and Mica is assured for flood control operation until 2024.
- Other Canadian storage [8.7 km³ (7 Maf) of Treaty storage & 6.2 km³ (5 Maf) of non-Treaty storage] is available "on call" for large floods at a cost.
- Cash payment (US$ 64 million) was made from U.S. to Canada at the completion of the three Canadian projects for 50% of the estimated value of future flood damages prevented in the U.S. (to 2024)

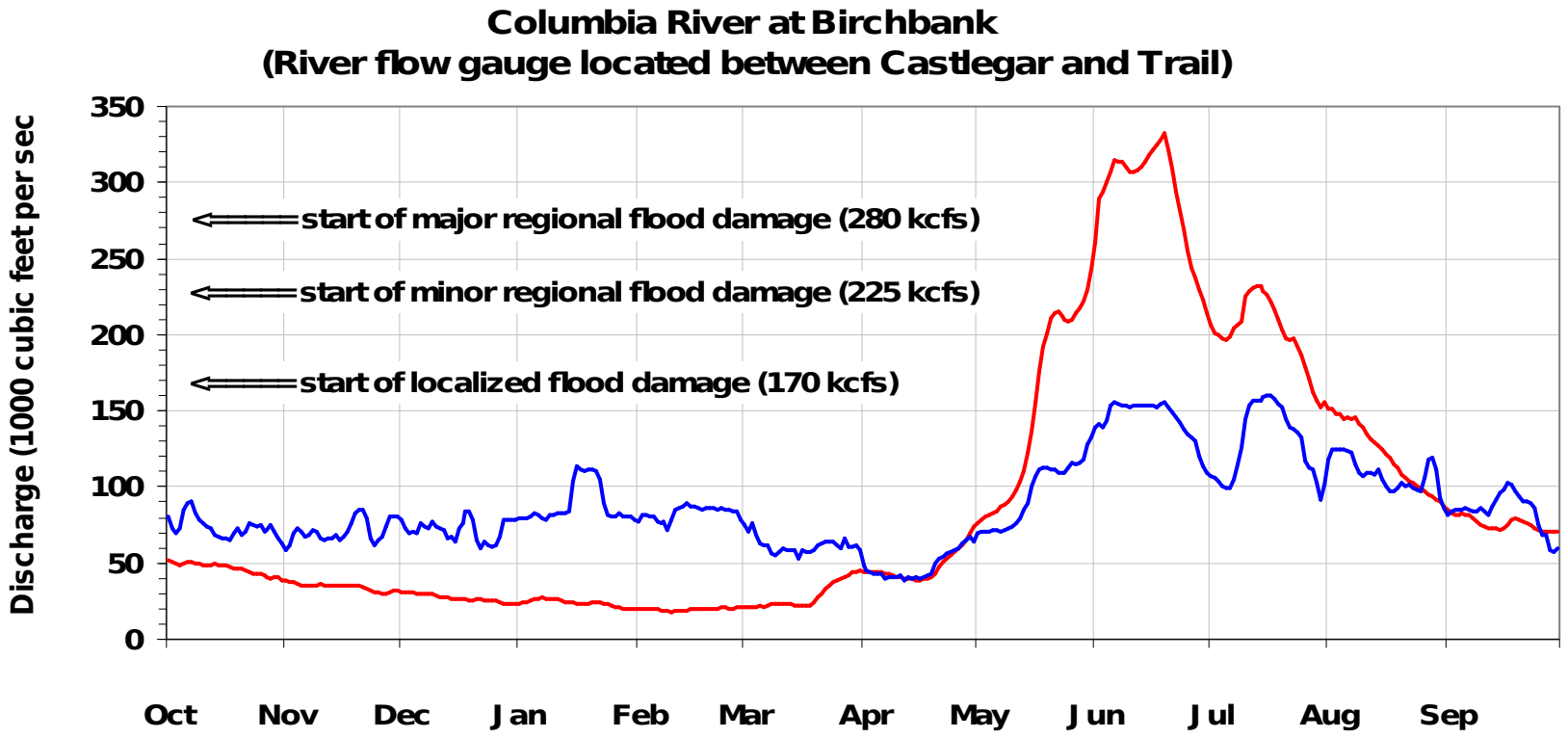
- Corps has estimated that Treaty storage prevented over US$ 200 million of damages in each of the years 1972, 1974, and 1997
- Many Canadian and U.S. communities benefit from Treaty flood control
- After 2024, the U.S. has access only to "on call" storage

Flood Control Benefits in Canada

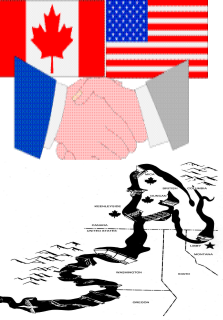
Columbia River Treaty



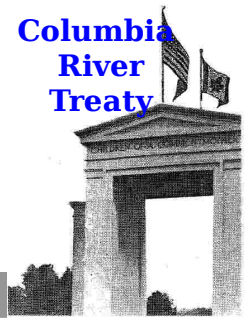


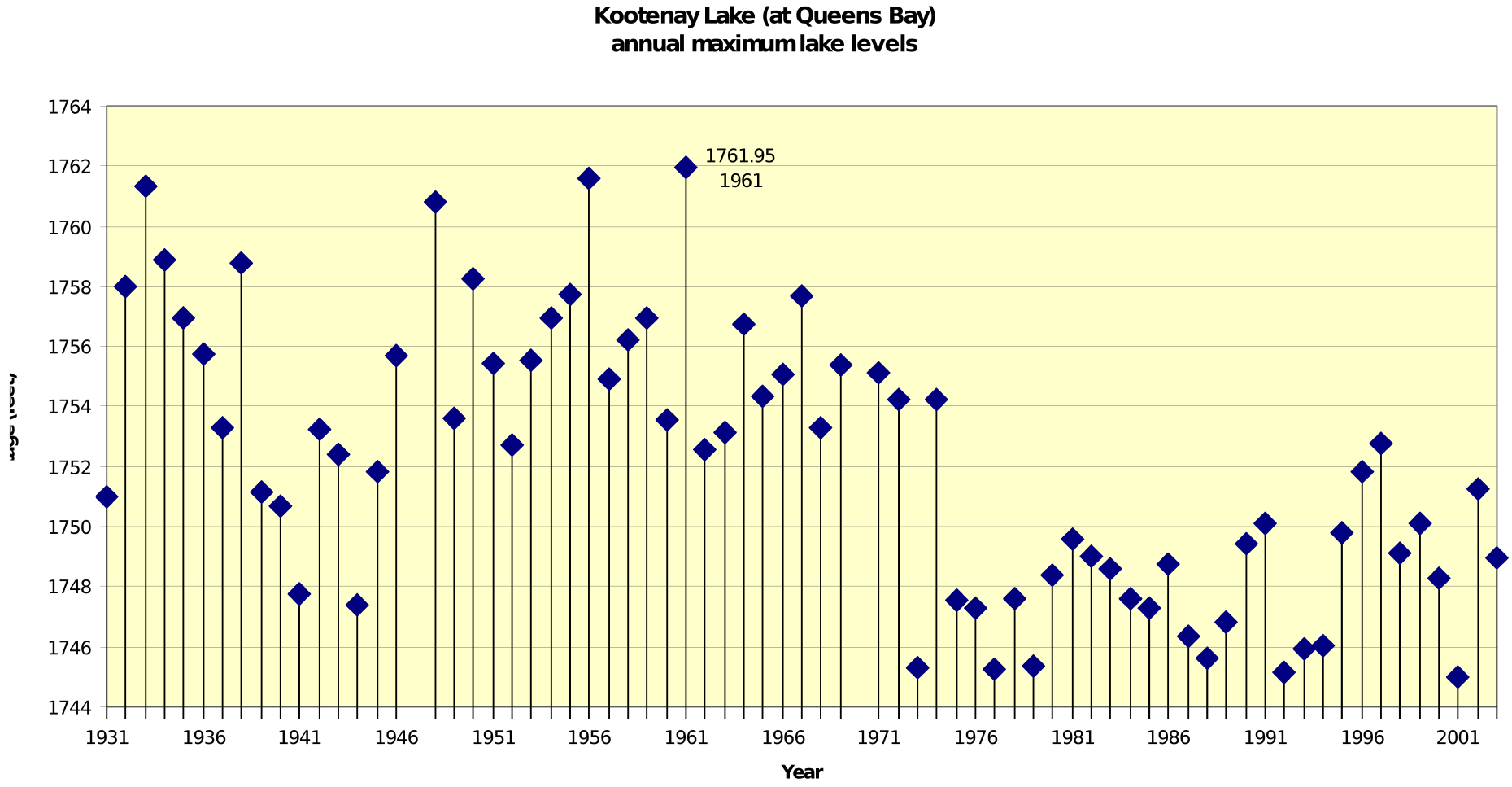


Peak Kootenay Lake levels before and after Treaty storage



Columbia River Treaty



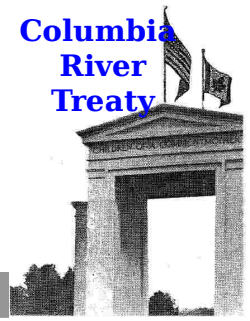


Treaty Provisions for Hydropower

- 19.1 km³ (15.5 Maf) of Canadian storage is operated for optimum power generation in Canada and the U.S.
- Canada receives 50% of the increase in power generation capability at U.S. plants due to the operation of Canadian Treaty storage.
- Canada is required to operate Treaty projects according to specified monthly operating plans. However, Canada has flexibility to operate individual projects for maximum Canadian benefit as long as the overall Canadian storage operation meets Treaty targets.
- Downstream power and flood control benefits resulting from Libby storage operation belong to the country where they occur, i.e., Canadian benefits stay in Canada.
- Treaty made other power projects in Canada & U.S. feasible;

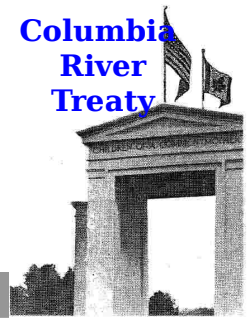
Types of Treaty studies

Columbia River Treaty



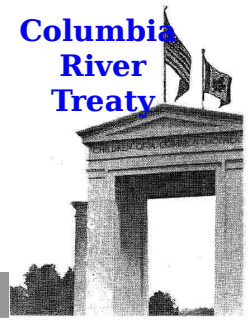
- ***Assured Operating Plan (AOP)***
  - done 6 years in advance (“planning” time horizon) … allows time for construction of new resources
  - downstream benefits calculated from AOP
- ***Detailed Operating Plan (DOP)***
  - *done just prior to the operating year … revises &/or confirms the operating rules that were agreed on in the AOP … only by mutual agreement*
- ***Treaty Storage Regulation (TSR)***
  - *implements the DOP rules within the current operating year based on the actual & forecast runoff for each Columbia River project*

Assured Operating Plans



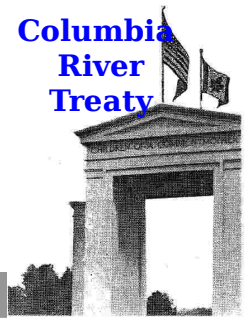
- The Treaty requires that an Assured Operating Plan (AOP) for Canadian Treaty storage be developed annually for the 6th succeeding year with the goal of achieving **optimum power benefits and specified flood protection** in Canada and the U.S.
- Optimum operating rules are judged based on the amount of firm and non-firm energy & capacity produced by using the rules
- Non-power requirements (e.g. fish and recreation) cannot be included in the AOP hydro-regulation studies.
- Once the AOP document is signed by both countries, it becomes the “default” (assured) plan
- The AOP is then reviewed by the Permanent Engineering Board (PEB), who determine if the plan meets the

Downstream Power Benefits



- Downstream Power Benefits (DSBs) are based on the AOP simulation studies, NOT on actual storage and power operations
- The Canadian Entitlement is 50% of the increase in energy & capacity downstream in the U.S. after adding Canadian Treaty storage.
- Canadian Treaty storage has “first-added” rights ahead of benefits from other U.S. storage projects built since the Columbia Treaty
- Canadian Entitlement deliveries are not affected or adjusted to reflect actual power benefits. (The U.S. can choose to use the resulting water for fish or ?, but the energy deliveries to Canada remain the same.)
- ✦ As of 1 April 2003, the 30-year sale of power benefits was completed, and all of the Canadian Entitlement energy and capacity now returns to the BC border

DSBs now return to Canada

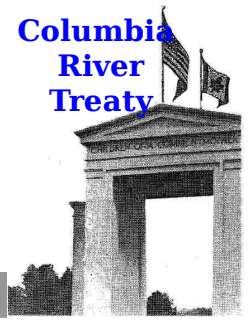


- The Province of BC owns the Canadian Entitlement to DSBs
- Approximate value ~ C$ 300 million per year
- Powerex is the Province's agent to sell the energy, either to BCH or to other customers
- BC Hydro remains the Canadian Entity for Entitlement deliveries and disputes – most disputes are related to firm transmission capacity to the U.S.-Canada border (e.g. PSANI)

- Typically, Powerex schedules Entitlement deliveries in the highest-value times:
  - Maximum capacity in most heavy-load hours
  - No deliveries in most light-load hours

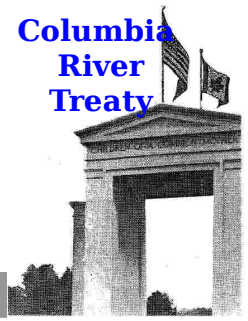
- For 2005-06, energy deliveries can peak at 1195 MW and must average 535 MW each month (45%

Treaty Allows Mutually Beneficial Operating Agreements



- Treaty allows the Entities to develop and implement Detailed Operating Plans (DOP) that produce results more advantageous to both countries than the AOPs that were prepared in accordance with only power and flood control objectives.
- Entities have interpreted “more advantageous” to include fisheries, recreation, and other benefits.
- Examples:
  - DOP (annual)
  - Libby Coordination Agreement (multi-year)
  - Supplemental Operating Agreements (annual)

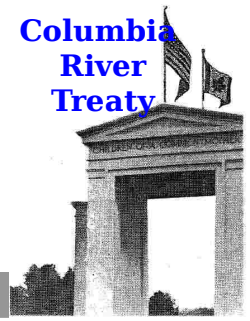
Detailed Operating Plan



- DOP prepared each year for the following operating year: Aug-July
- DOP must be accepted by agreement (or else we stay with the AOP)
- DOP may include fisheries and other benefits (in addition to power and flood control) if agreed to by both countries
  -- must be mutual benefit

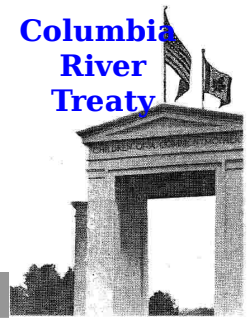
Treaty Storage Regulations

Columbia River Treaty



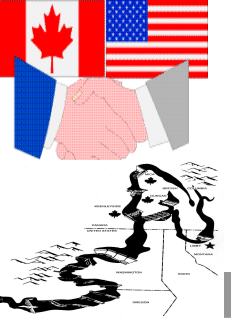
- TSR = Treaty Storage Regulation
- implements the rules of the DOP within the current operating year
  - uses the 6 rule curves with priority on flood control, firm power, refill, secondary power
- uses actual inflows to date plus forecast inflows to the end of the operating year
- models the entire Columbia River basin
- may allow proportional draft of Treaty storage

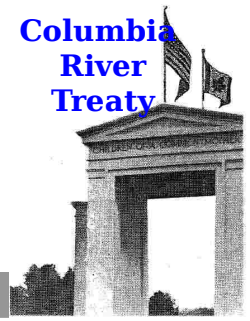
Columbia River Treaty



Actual operations

- ***TSR study (monthly storage targets) provides the starting point (rights & obligations) for all operations of Treaty projects***
- ***U.S. & Canada can agree to deviate from the TSR study, typically using supplemental agreements***
- ***Weekly conference call (Thursday 11 am) with U.S. and FortisBC to discuss the Treaty flow request for the following week (starts Saturday 8 am)***
- ***Treaty flow agreement is finalized by Friday Noon***
- ***Within-week flow shaping needs are accommodated whenever possible***

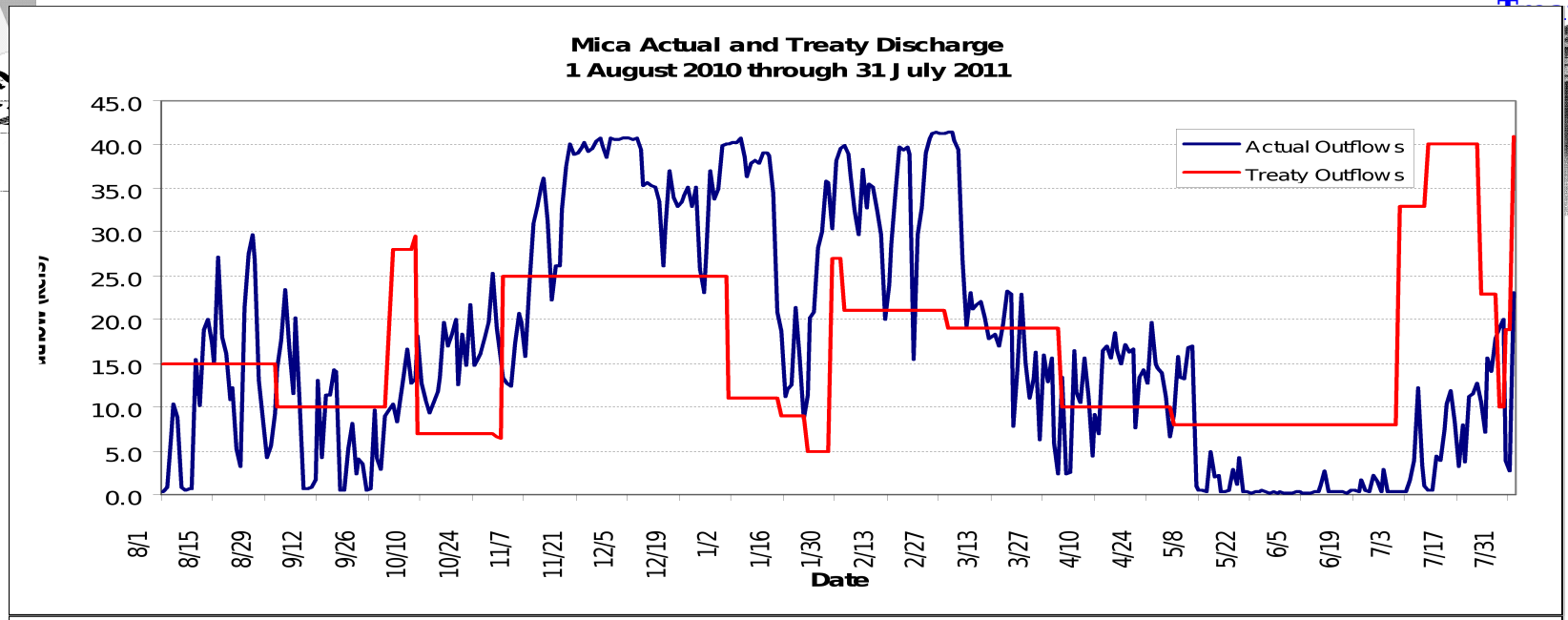


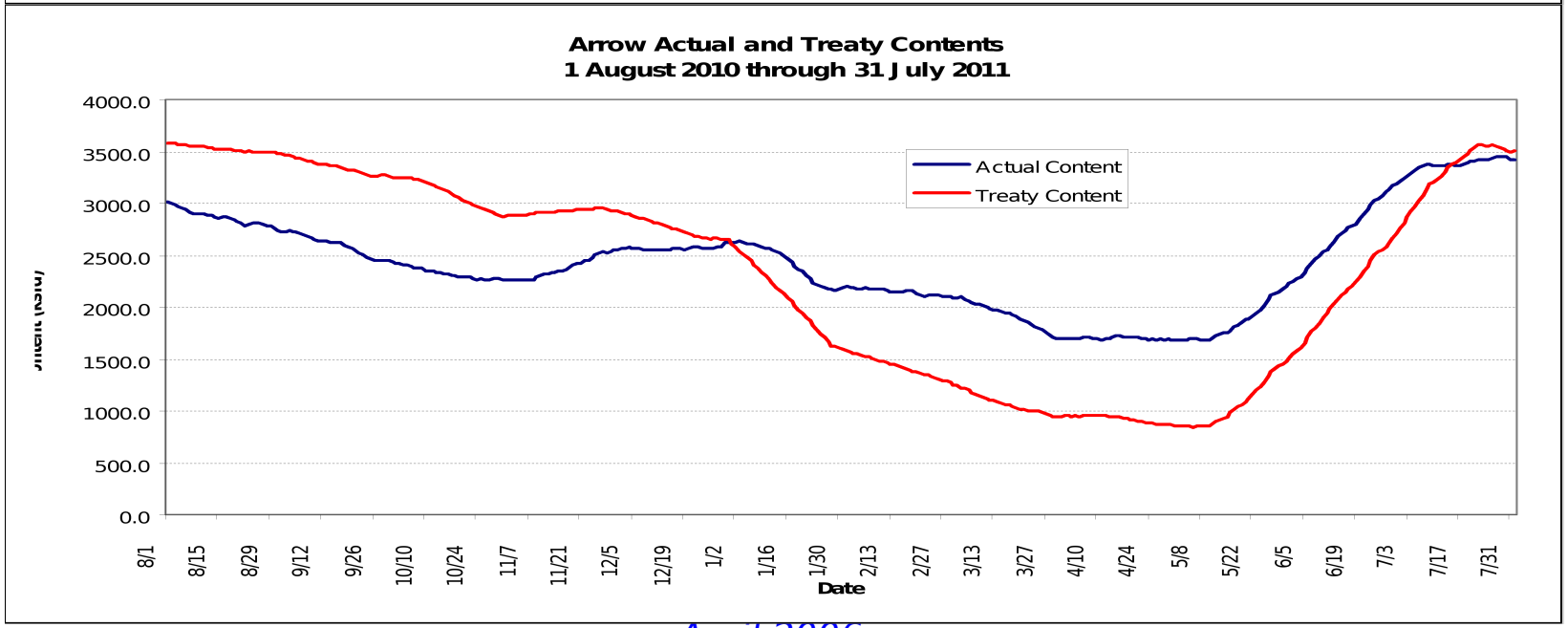


Actual operations (2)

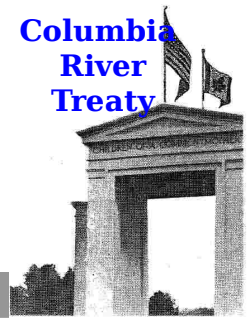
- ***Canada has rights to flexibility within Canada, i.e. transferring water between Mica, Revelstoke, Arrow, and Duncan reservoirs. Examples of this:***
  - ***running Mica/Rev more or less than that required by the TSR study (no Arrow discharge adjustment)***
  - ***running Duncan more or less than the TSR requirement (Arrow discharges must be adjusted in this case)***
- ***Non-Treaty activity is "superimposed on top of" Treaty activity for Mica, Rev, and Arrow***

Actual vs Treaty Operation - Flex





Supplemental Operating Agreements



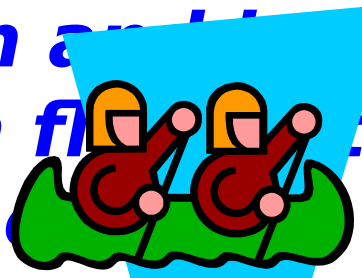
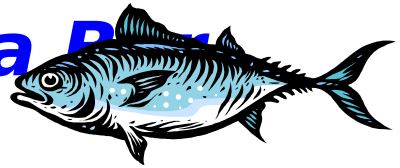
Since 1984, the annual Detailed Operating Plan has allowed supplemental operating agreements within each operating year as opportunities arise for mutual benefits.

Some examples:

- Nonpower Uses Agreement
- Libby/Canadian Treaty Storage Swap
- Summer Treaty Storage Agreement (July/01-Mar/02)

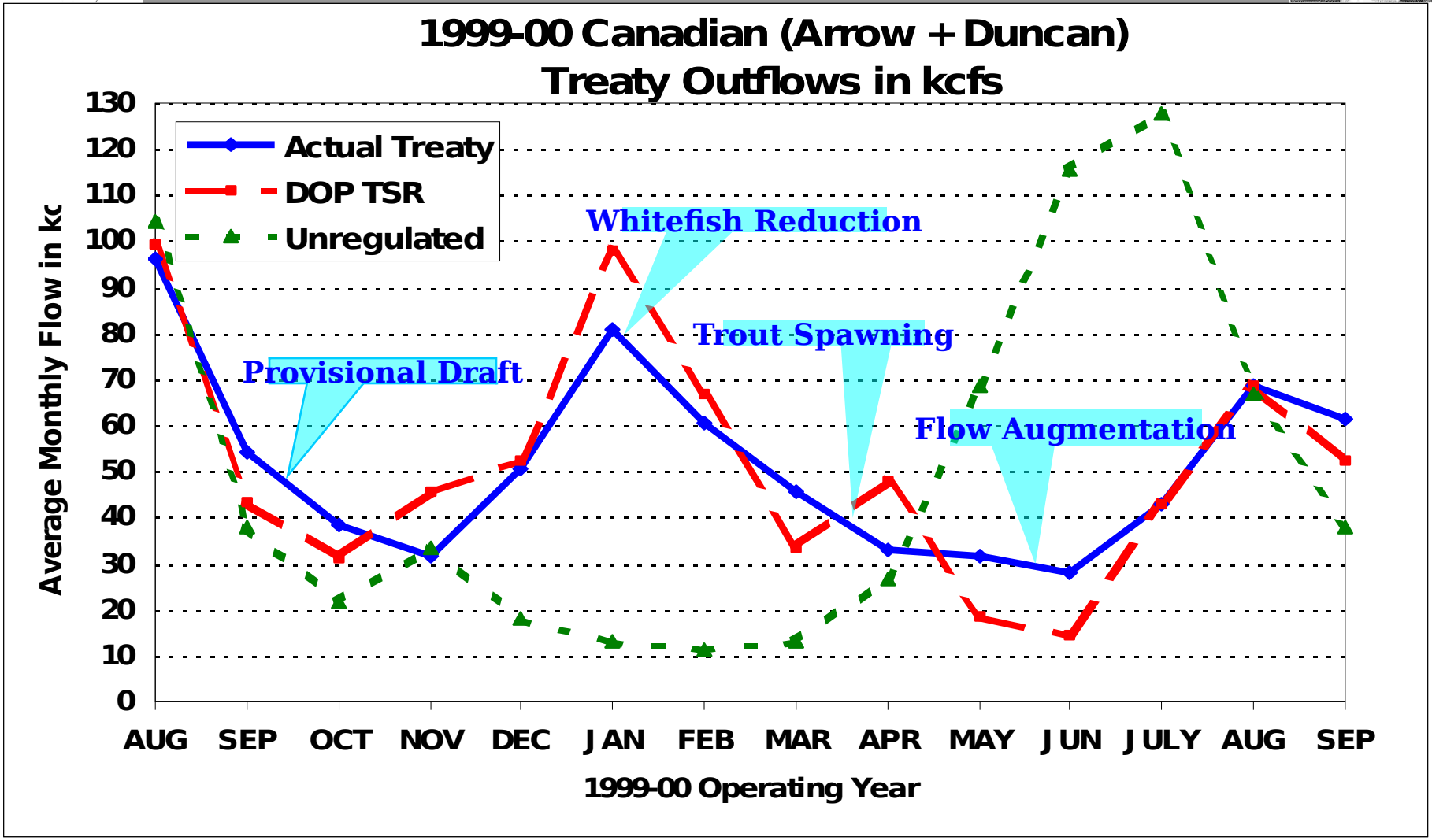
Non-Power Uses Agreement

- adjusts Arrow outflows during Jan-Mar for whitefish spawning, and during April-June for trout spawning (Canadian fish benefit)
- helps smooth the refill of Treaty reservoirs
- enables 1 Maf storage for salmon flow augmentation and helps meet minimum fish flows at Vernita Bar (fish benefit)

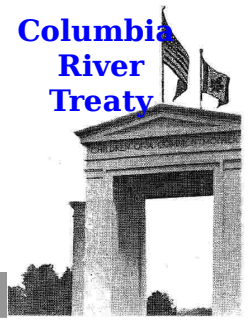



Changes from TSR Operation

Columbia River Treaty

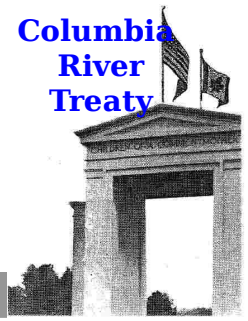


Non-Treaty Storage Agreement

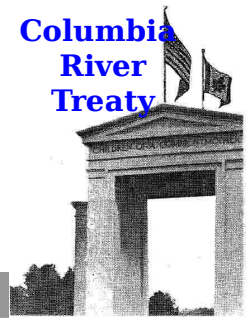


- *allows for coordination of additional storage in Canada that is not governed by the Treaty*
- *designed as a bilateral agreement between BPA and BCH*
- *has been used by both BPA and BCH since 1984 to provide additional flexibility for power and non-power benefits*
- *BCH and BPA each have access to 1.5 MAF of storage*
- *NTSA activity can affect reservoir levels and discharges at both Mica and Arrow due to Treaty flexibility*

Benefits of NTS Agreements



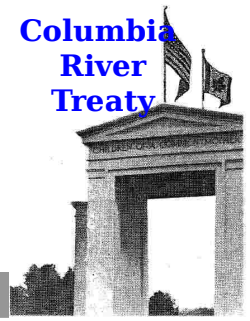
- *Use of non-Treaty storage can provide both power and non-power benefits. Power benefits are created by:*
  - *storing water when it has less economic value and releasing it when it has more economic value ($ gain)*
  - *shaping water so that energy is produced from water that would otherwise be spilled ($ and MW gain)*
- *In recent years, non-Treaty storage has become an important part of BPA's ability to shape flows for fisheries, in addition to providing power benefits.*



NTSA (cont.)

- *The most recent NTSA was executed on 10 April 2012 and will remain in effect until 15 September 2024*
- *This agreement also provides BPA firm rights to water to support ESA-listed fish in the lowest 20th percentile of water years*
- *BC Hydro has firm release rights for power planning purposes in their lowest water conditions*
- *The NTSA provides additional flow shaping capability within the year and between years for both fish and power.*

Columbia River Treaty



Questions?